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Land use and land cover pattern analysis of Chambal Division in 2022 Using Remote sensing and GIS

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Abstract - *Land Use and Land Cover defines the pattern of natural geographical landscape and also how human utilize that land as resources. Human always modify the natural landscape as he can for their benefits, growth and development. To analysis the land use and land cover pattern in Chambal division is the primary goal of this project. To prepare map of land use and land cover of Chambal division is the secondary goal of this project. Both primary data and secondary data is used in this study. Landsat satellite imageries of Landsat-8 and 9 are used as primary source of data. Satellite imagery is downloaded from USGS (United States Geological Survey) of Landsat series imageries. ArcGIS 10.8 and Q-GIS 3.44.2 software are used to analysis the land use and land cover pattern. Supervised classification techniques are used to classify the image. The outcomes of the experiment are discussed and presented.*

Key Words: Land use and Land Cover, Chambal division, Supervised image classification, Remote sensing and GIS.

1. INTRODUCTION

Land cover is defined as the physical appearance of earth's surface which can be directly seen through human eyes, aerial photographs, satellite imageries etc. such as; waterbody, forest area, grassland, etc. Whereas, Land use is defined as the involvement of human being with natural cover and how human utilised the land to fulfil different need and purposes such as, agricultural land, built-up areas and recreations etc. Remote sensing is that techniques in which information is collected with different tools such as; aerial cameras, satellite sensors etc. without being in physical contact. GIS stands for Geographical Information System and it is the computer-based tool in which user can capture, store, visualise, manipulate and analyse the spatial data. It answers the questions such as; any object or phenomenon where it is located, why at that place located also helpful about the better place or opportunities of that object or phenomenon where it can happen better at another place.
Anderson developed the land use and land cover classification system in 1971 for coordination's and provide the standard criteria which can apply on high altitude aerial photographs and satellite data that fulfil the following conditions: 1. The accuracy assessment of image classification should be more than or equal to 85 percent. 2. The accuracy assessment of all categories of image classification should be approximate equal. 3. Same results should be found even when classification is performed by different users and at different times. 4. The classification system is suitable for large geographical areas. 5. The classification should be in such a way that vegetation and other forms of ground cover can serve as representative for activities. 6. The classification system should be helpful for any aerial photographs and satellite imageries acquired at different seasons of the year. 7. Classification of sub-categories must he precise more than ground survey or enhanced quality of photographs or imageries. 8. Aggregation of categories should be possible. 9. Image classification should be helpful for comparison with future land-use data. 10. Whenever possible, diverse land uses should be recognized. Some of these conditions should be fulfilled during the image classification and some during land use land cover image interpretation.

2. STUDY AREA

Chambal division is a geographically and political location which situated in Northern part of Madhya Pradesh. Bhind, Morena and Sheopur three districts are in Chambal division. Total geographical area of Chambal division is approx. 16012 square kilometers. The extension of Chambal division is from 25°15' to 26° 48' North latitudes and from 76°31' to 79°15' Eastern longitude coordinates. Chambal river makes the Northern, northwestern, and north-eastern boundaries of the division with Rajasthan and Uttar Pradesh. Parbati river makes 63.5 kilometers border of Chambal division with Rajasthan in west. Further, Barbati (Kul), Bamnidai and Kosam rivers make boundary of division with Rajasthan in South-west direction. Shivpuri, Gwalior and Datia district of Madhya Pradesh make the border with division in south from west to east respectively. Bhind, Morena and Sheopur districts are situated on the bank of Chambal River that's why this entire geographical area is called Chambal division. Its valley is wider on the right bank in Madhya Pradesh and is about 60 km wide in the north-east falling in Ambah and Morena tahsils. In the Sheopur tahsil, the valley is quite open but the middle section between Sabalgarh and Raghunathpur is very

narrow. Pahuj River is the tributary of Sindh River which flows for approx. 68.7 kilometers in Chambal division and makes the eastern boundary of Chambal division with Jalaun district of Uttar Pradesh. Parbati and Barbati rivers make 63.5 kilometers and 3.75 kilometers western border of Chambal division with Kota district of Rajasthan respectively. Sindh River makes 26 kilometers border between Bhind district of Chambal division and Datia district. Asan River and Sank River make the boundary of Chambal division with Gwalior district for 19 kilometers and 4.9 kilometers respectively.

3. OBJECTIVES

- To analysis the Land use and Land cover pattern in Chambal division.
- To prepare the map of Land use and Land cover of Chambal division.

4. RESEARCH TECHNIQUES

This study of based on primary as well as secondary data. Source of primary data is SOI (Survey of India) topographical maps and other ancillary data is used. Also, satellite imageries are used from LANDSAT-8 and LANDSAT-9 for the year 2022 to analyse the land use land cover pattern. Two adjacent satellite imageries are used cover the whole Chambal division. Satellite imageries are downloaded from USGS (United States Geological Survey) of Landsat series. Secondary data such as; raw data/ shapefiles etc. are collected from Survey of India for helping map making.

For analysis of data primarily Remote sensing and GIS techniques is used. Visualization interpretation of satellite imagery is be used to create various thematic layers such as Land use and Land cover, drainage, etc. Other Digital analysis techniques and Hybrid analysis 3 techniques is used for analysis of data. Spatial resolution of Landsat satellite imageries are 30 meters. But for the year-2022 land use land cover analysis, by using Pan-sharpening tool in QGIS, resolution has been enhanced with the help of Band-8 Panchromatic and work on final 15 meters spatial resolution.

Table -1: Details of Satellite Data Used

Sensor	**Path**	**Row**	**Spatial resolution**	**Date of Data Acquisition**
LANDSAT-8 OLI/TIRS	145	42	15 meters (Enhanced)	31st May, 2022
LANDSAT-9 OLI/TIRS	146	42	15 meters (Enhanced)	30th March, 2022

Supervised image classification with the Interactive Supervised Classification was performed to obtain the land classes. Composite band of RGB with a combination of bands 4–3–2 (NIR-R-G) for Landsat 5 (TM) images and composite band of RGB with a combination of bands 5-4-3 (NIR-R G) Landsat 8 (OLI) images, were employed for processing since they worked well for mapping land use. Accuracy assessment points (GCP) are created with simple random sampling technique 15 meters (Enhanced) 30th March, 2022 in classified image to confirm the accuracy of classification to plot these GCP on Google Earth Pro software.

5. RESULTS AND DISCUSSION

Categories of land use and land cover are classified in Level-I and Level-II on the basis of classified system introduced by National Remote Sensing Agency.

Table -2: Land use Land cover Classification System in Chambal division

Sr. No.	**Level-I**	**Level-II**	
1	**Built-up Land**	1.1	Built-up Land
2	**Agricultural land**	2.1	Crop land
3	**Forest land**	3.1	Dense forest
		3.2	Open Forest
		3.3	Forested Ravines
4	**Wasteland**	4.1	Ravenous land with or without scrub
5	**Water Bodies**	5.1	River/Stream/Lake/Reservoir/Tank/Canal
Computed by Research scholar			

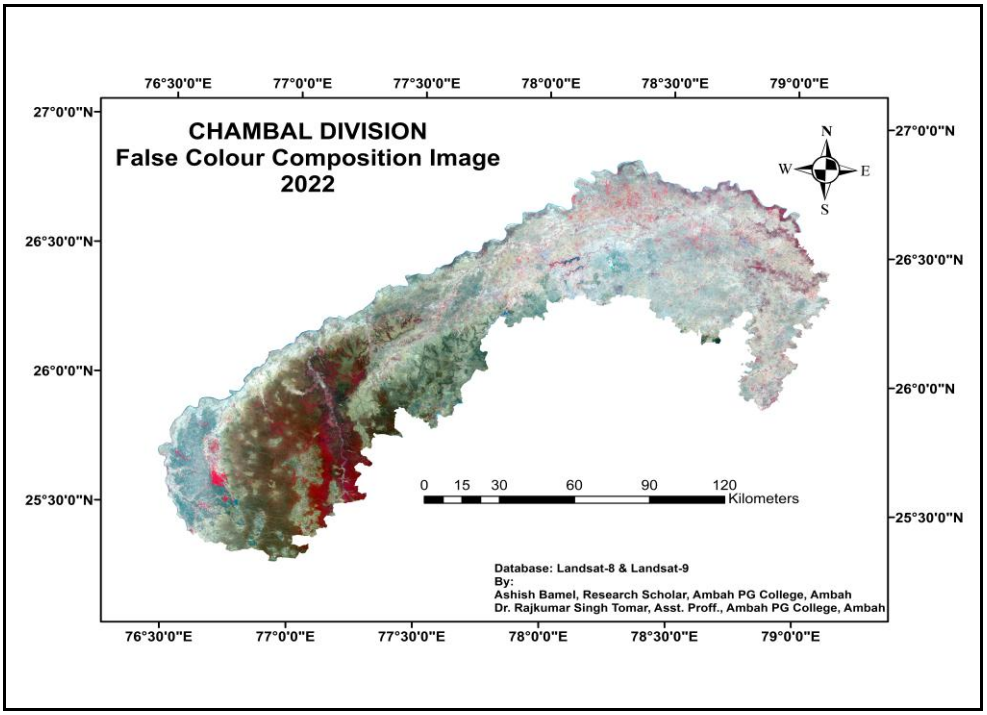

Fig.-1: FCC Image of Chambal division

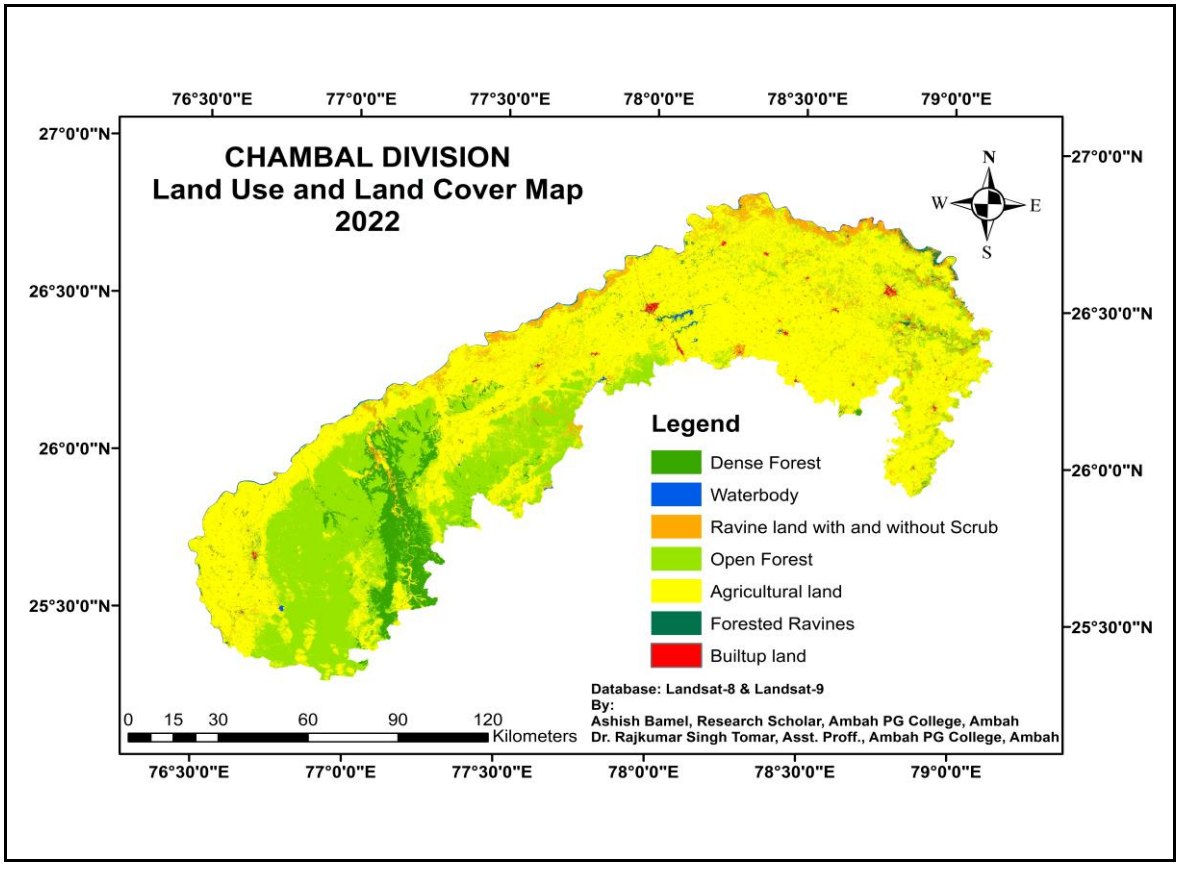

Fig.-2: Land Use and Land Cover Map of Chambal division

The area of LULC classes with percent to total geographical area is represented below in table-3.

Table -3: Land Use Land Cover Classes with area in Chambal Division

Class	**Area in km²**	**Percentage**
Dense Forest	850.42	5.31
Waterbody	83.80	0.52
Ravines with Scrub	792.94	4.95
Open Forest	4597.04	28.71
Agricultural land	9523.24	59.47
Forested ravines	157.50	0.98
Built-up land	7.38	0.05
TOTAL	16012.33	100
Source: LULC Classification by Research Scholar		

According to the dataset of table -3, maximum area percent 59.47 is agricultural land in Chambal division with 9623.24 square kilometers geographical area and its significant extension appears in Bhind district, middle and eastern Morena and some area in north-western Sheopur district. After agricultural land, secondly maximum area percent 28.71 is open forest land cover with 4597.04 square kilometers geographical area and its significant extension appears in Middle Sheopur district and south-western Morena district. Third major Land cover class is Dense vegetation in Chambal division with 5.31 percent area and 850.42 square kilometers geographical area. Its significant extension appears along Kuno river in Sheopur district. Fourth and famous land cover class is Ravine land with and without scrub in Chambal division with 4.95 percent area and 792.94 square kilometers geographical area. Its signification distribution appears along the Chambal, Kunwari and Sindh rivers. After this, forested ravines is the major land cover in Chambal division with 0.98 percent area and 157.50 square kilometers geographical area and its extension appears along Chambal River in north-eastern part of Chambal division. Waterbody is the next major category with 0.52 percent area and 83.80 square geographical area. It appears as Kotwal reservoir and Pagara reservoir on Asan River, Narsinghpur dam on Sank River, Awada dam on Sip (Seep) River also various ponds, lakes and rivers in Chambal division. Built-up land is extended over 0.05 percent area and 7.38 square kilometers geographical area.

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